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MECHANICAL-PROPERTY DATA
Ti-6Al-4V-3Co

Aged Bar

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Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

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Ti-6Al-4V-3Co

The 3Co addition to the normal Ti-6Al-4V composition is a recent development to attempt to improve the properties of titanium alloys. Additions of 2 and 4 percent cobalt have also been studied. This particular material was obtained from the Cobalt Information Center in the form of round bar and was heat treated (as suggested by the Center) as follows: solution treat at 1450 F for 45 minutes, water quench, temper at 900 F for 4 hours. As can be seen from the data, the mechanical properties are improved over the conventional 6Al-4V alloy. However, the fatigue data show the material to be more notch sensitive then Ti-6Al-4V. From the creep and rupture data it can be seen that the 6Al-4V-3Co alloy has excellent creep-rupture strength at 500 F; however, it is very sensitive to small changes in stress. Also, at 700 and 850 F, short times at temperature show very good strength properties. A rapid drop in strength appears at long times at temperature.

Ti-6Al-4V-3Co Data[a]

Condition: STA
Thickness: 1/2- and 7/8-Inch Round Bar

Properties	Temperature, F RT	500	700	850
Tension				
F_{tu}, ksi	203.6	170.0	158.3	124.3
F_{ty}, ksi	194.6	145.0	129.0	108.3
e_t, percent in 2-in.	12.5	17.8	21.6	35.7
E_t, 10^6 psi	17.6	15.6	14.4	12.2
Compression				
F_{cy}, ksi	197.0	147.3	130.7	116.0
E_c, 10^6 psi	17.8	15.9	14.9	13.0
Shear[b]				
F_{su}, ksi	122.6	U[c]	U	U
Impact (V-notch Charpy)	U	U	U	U
Fracture Toughness, K_{Ic}, ksi $\sqrt{in.}$ [d]	U	U	U	U
Axial Fatigue[e]				
Unnotched, R = 0.1				
10^3 cycles, ksi	214	200	U	156
10^5 cycles, ksi	167	140	U	106
10^7 cycles, ksi	135	135	U	95
Notched (K_t = 3.0), R = 0.1				
10^3 cycles, ksi	115	115	U	105
10^5 cycles, ksi	50	50	U	41
10^7 cycles, ksi	46	46	U	40
Creep				
0.2% plastic deformation 100 hr, ksi	NA	110.0	58.0	6.0
0.2% plastic deformation 1000 hr, ksi	NA	90.0	38.5	2.0
Sress Rupture				
Rupture 100 hr, ksi	NA	165.0	123.0	61.0
Rupture 1000 hr, ksi	NA	165.0	119.0	40.0

Properties	Temperature, F			
	RT	500	700	850
Stress Corrosion				
F_{ty}, 1000 hr max	U	--	--	--
Coefficient of Thermal Expansion				
5.71×10^{-6} in./in./F (70-900 F)				
Density				

(a) Data are average of triplicate tests conducted at Battelle unless otherwise indicated. Fatigue, creep, and stress-rupture values are from data curves generated using a greater number of tests.

(b) Double-shear pin type specimen, 1/2-inch diameter.

(c) U, unavailable; NA, not applicable.

(d) Subject material was in round-bar form and not of sufficient size to conduct conventional fracture-toughness tests.

(e) "R" represents the algebraic ratio of the minimum stress to the maximum stress in one cycle; that is $R = S_{min}/S_{max}$. "K_t" represents the Neuber-Peterson theoretical stress-concentration factor.

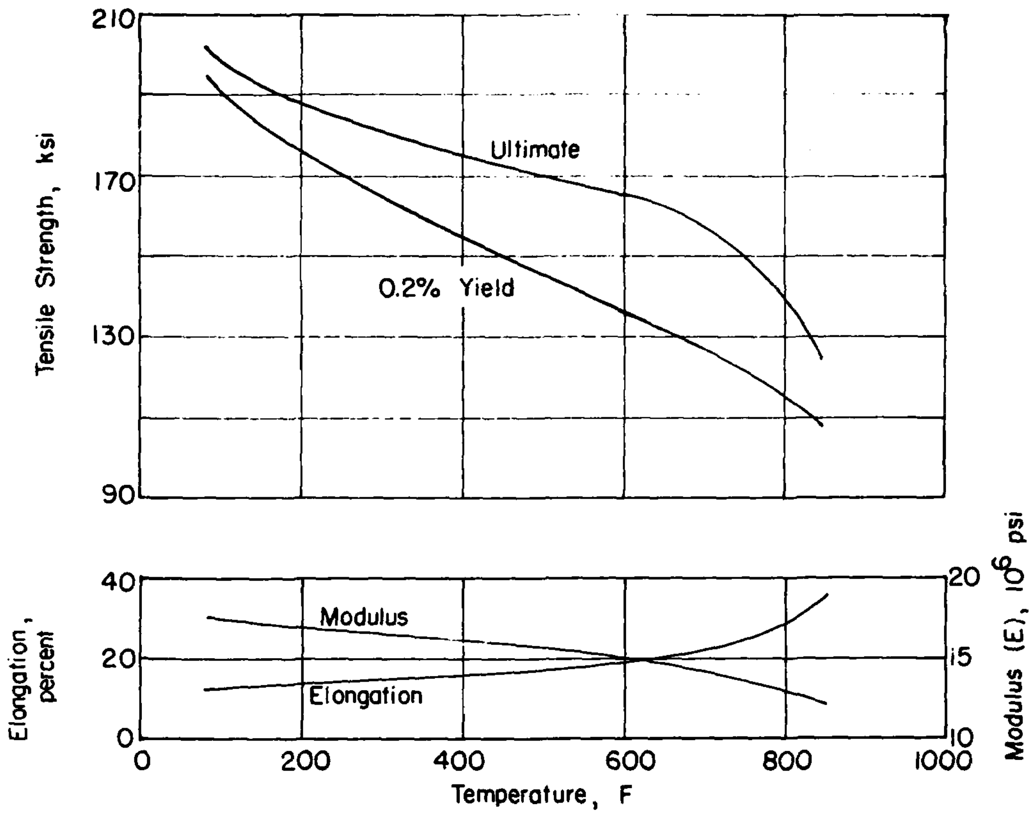

FIGURE 1. EFFECT OF TEMPERATURE ON THE TENSILE PROPERTIES OF Ti-6Al-4V-3Co ROUND BAR

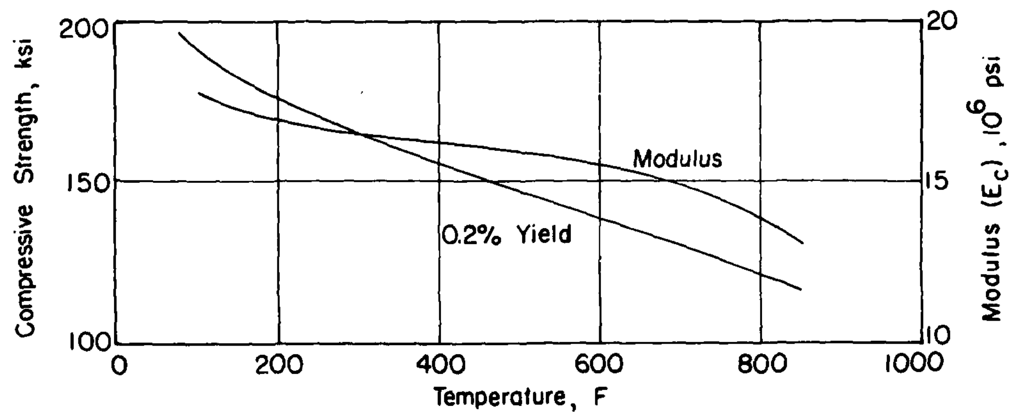

FIGURE 2. EFFECT OF TEMPERATURE ON THE COMPRESSION PROPERTIES OF Ti-6Al-4V-3Co ROUND BAR

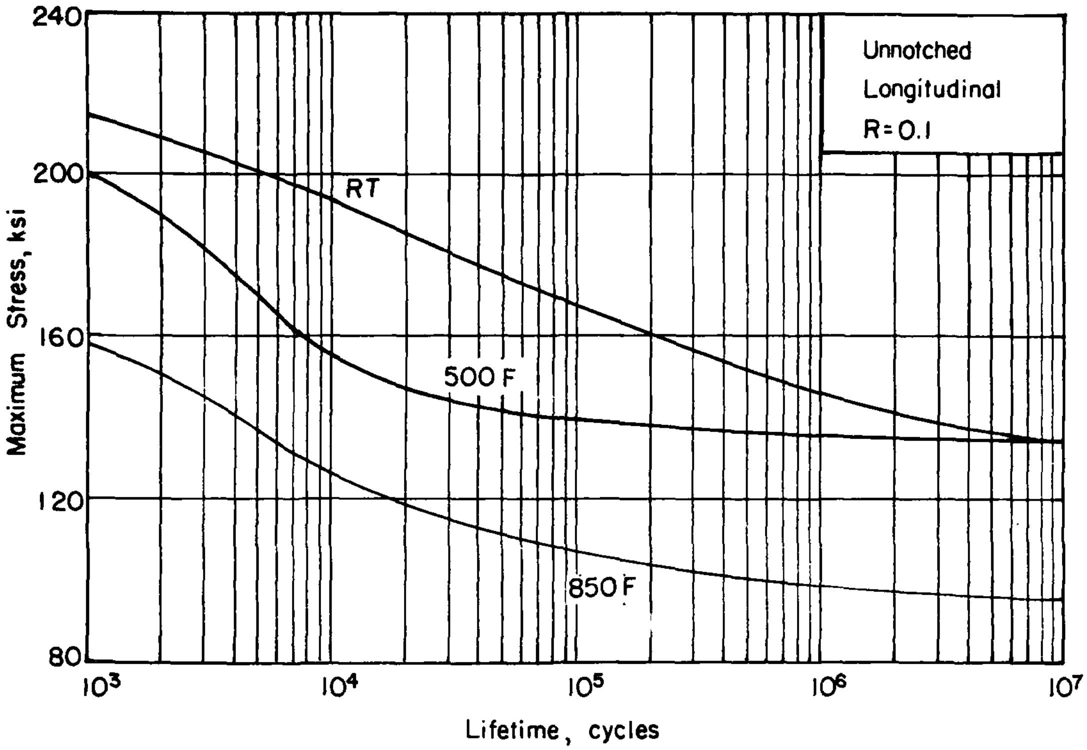

FIGURE 3. AXIAL-LOAD FATIGUE RESULTS FOR Ti-6Al-4V-3Co ROUND BAR AT THREE TEMPERATURES

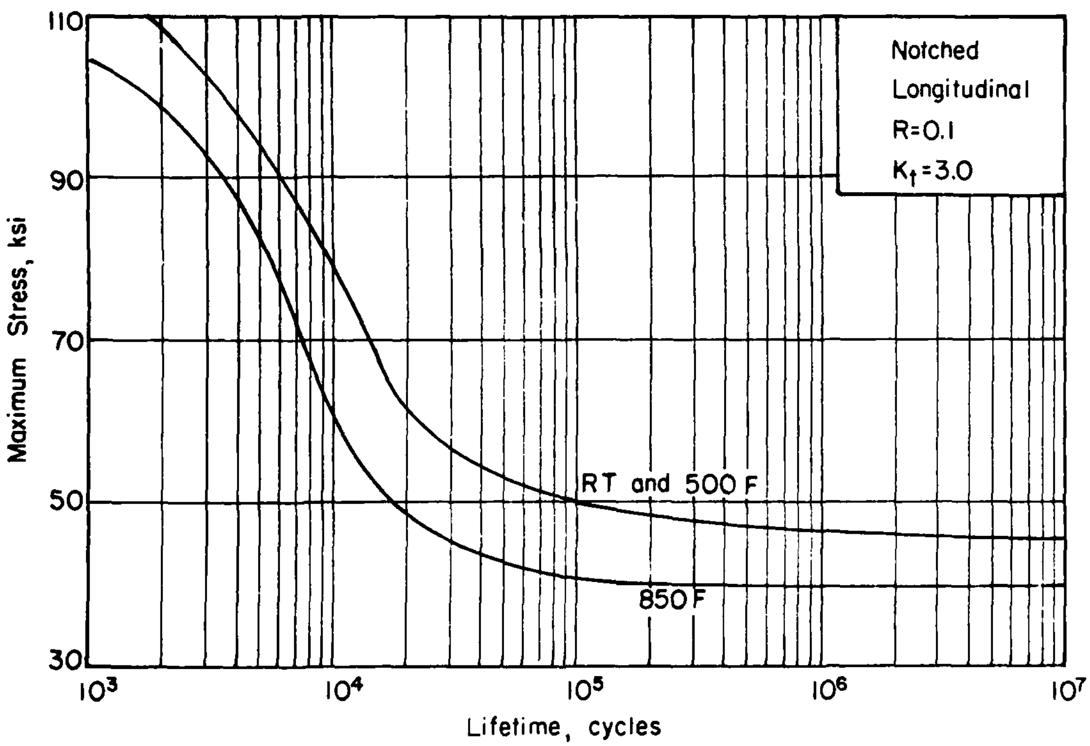

FIGURE 4. AXIAL-LOAD FATIGUE RESULTS FOR NOTCHED (K =3.0) Ti-6Al-4V-3Co ROUND BAR AT THREE TEMPERATURES

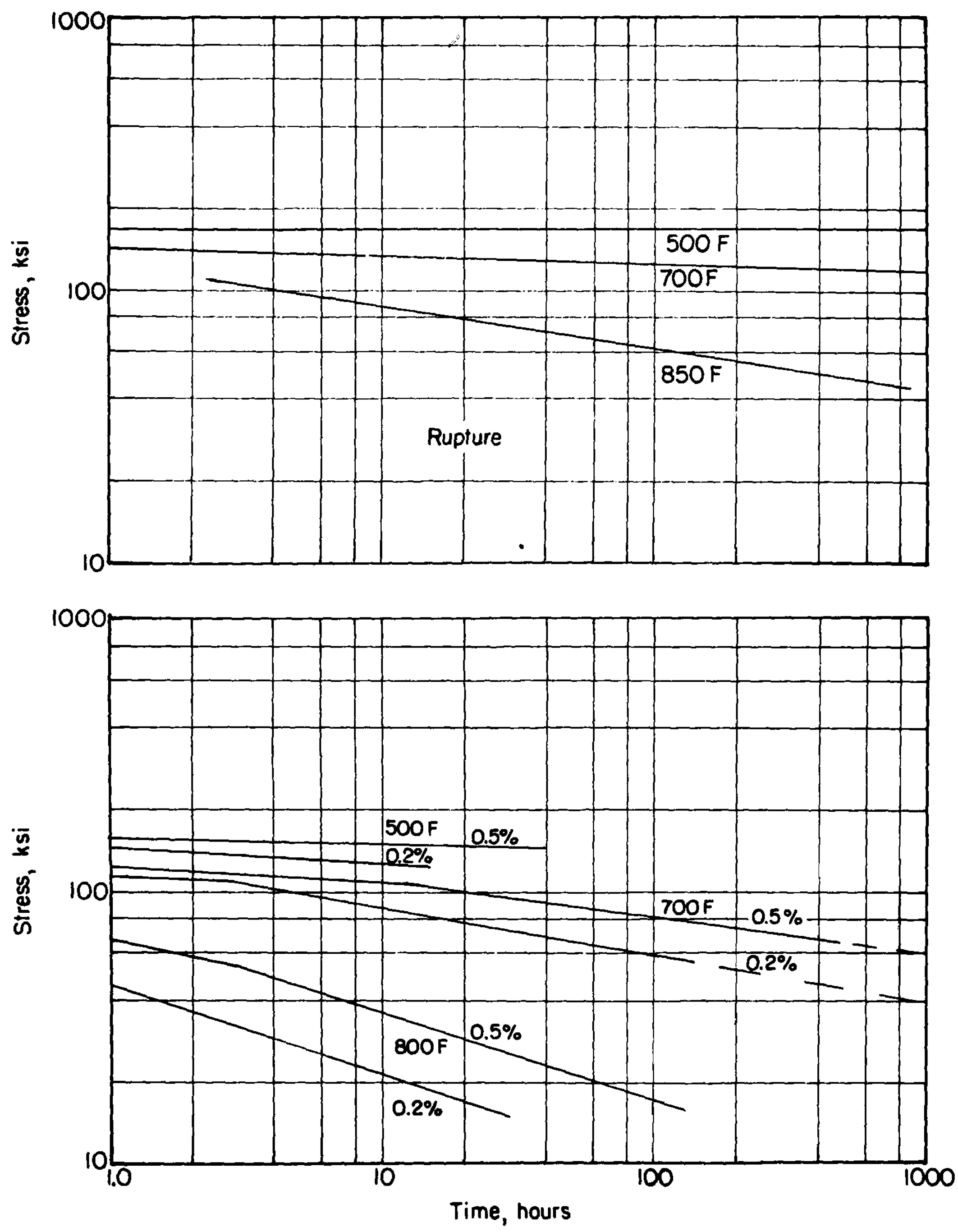

FIGURE 5. STRESS-RUPTURE AND PLASTIC DEFORMATION CURVES FOR Ti-6Al-4V-3Co ROUND BAR

REFERENCES

(1) Diderrich, E., "Contribution to the Study of a High-Strength Titanium Alloy", paper published by "Centre D'Information du Cobalt", Brussels, also published in Cobalt, No. 31, June 1966, pp 78-82.

(2) Sparks, R. B., "Preliminary Investigation of Ti-6Al-4V-3Co Alloy", Report No. RD 67-137, M. D. &E. No. 254, Wyman-Gordon Company.

(3) Diderrich, E., "Addition of Cobalt to the Ti-6Al-4V alloy", paper presented at the 96th Annual AIME Meeting, Los Angeles, California, February, 1967.